THE TECH

Special Issue -- NAVAL ARCHITECTURE

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INSTRUCTORS AND STUDENTS IN COURSES XIII AND XIII A

WARSHIP DESIGN AND CONSTRUCTION

By WILLIAM HOVGAARD.

The course in warship design and construction being laid out with the special purpose of preparing young naval officers for duties as Naval Constructors, pre-supposes a general knowledge of warships and seamanship, of the life on board ship, of the service in the navy, and of the installation and use of artillery and torpedoes. In fact, not only must the designer of warships be a constructor, but he must understand the requirements of the nautical and military service of the navy. Most of the freak designs, which have been brought out, and, in many cases, realized at great cost, have been made by men unacquainted with these requirements.

The design of warships differs essentially from that of merchant ships. While the greater part of the displacement of a merchant ship is taken up by a dead weight carried as cargo, the corresponding weight in a warship is carried as a complex armament and system of protection, and the systems of ventilation, heating, drainage, communication, and also all living accommodations are of a completeness only equalled in high-class passenger steamers. Hence the greater complexity of warships as compared with merchant vessels.

Moreover, the design of merchant vessels, and, in particular, their structural arrangements and details, are determined almost absolutely by the rules of the classification societies, which give the scantlings of every important member of the structure, once the principal dimensions and size of the ship are settled. In warships, no such rules or tables are given for the guidance of the designer. Each dimension and scantling has to be determined by the designer independently, based on experience and precedent, aided by calculations wherever practicable. In many cases, however, the problems occurring in the structure of warships are too complex to permit of exact calculations. Empirical formulae expressing a comparison of certain main features may often be used, but, in many cases, nothing but an interpolation between the scantlings used in ships of similar type and size is left to the designer. Therefore, judgment and experience counts for more in warship design than in most other branches of engineering.

Probably in no other branch of engineering has there been such a variety of types proposed, and carried into practice, as in the construction of warships. The complexity of the requirements of the service has led to an almost bewil-

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COURSE IN NAVAL ARCHITECTURE AND MARINE ENGINEERING

By C. H. PEABODY.

The course in naval architecture and marine engineering offers instruction to those who expect to be ship-builders, ship-designers, ship-managers or marine-engine builders (including marine steam turbines). The long and cumbersome title is forced on us by the commonly accepted use of the terms which historically connect the building of the old wooden sailing ship with the construction of the modern steel steam-ship. When built of wood, houses and ships have many resemblances and in mediæval titles both were picturesque. The architect was then designer and master-builder. However it may be with the architect, the naval architect must not loose the quality of being master-builder and that quality must include both structure and propelling power. Again, at the transition from sail to steam the naval architect accepted the steam engine as designed and built by the engineer. The ship carpenter worked in wood and the machinist in iron and the line of demarcation was clear. But the shape and structure of the hull had to be modified to meet the new conditions of propulsion and the machinery had to be developed to meet the conditions of service; both are now made of steel, and the lines of demarcation depend on custom. By custom the design of a ship and the machinery is intrusted to a naval architect and a marine engineer ,but the designs so overlap that harmonious results can be attained only by close association and is best attained when there is one master-builder who decides all.

This discussion might appear to be merely curious if not idle, did it not in a measure deal with common impressions, which tend to narrow the conception of the work of the department. The course as will be seen by inspection of the schedule in the catalougue is a broad course; its application is so far limited as man's interests on shore are more extensive than at sea.

To those who intend to enter the course it may be said that the best preparation is a good all round training as afforded by our first and second years. In order to succeed one must be able to do his mathematics and drawing with reasonable facility; but that is true for any engineering course. Of the later work, the applied mechanics and steam-engineering are as much professional work as in naval architecture itself.

The lectures on naval architecture deal with displacement and stability, with the determination and application of the power required for propulsion, and with the theory of waves and their influence on the steadiness and safety of a ship at sea.

The lectures on marine engineering deal with the development of power by reciprocating engines and by steam turbines, and with the size and proportions requisite for strength and stiffness of their machines. Also with the vibration produced by engines and methods of avoiding or reducing such vibrations.

In the drawing room each student design a sailing yacht and a steamship, making all the customary calculations for displacement, stability and strength, including also a launching problem. The design is accompanied by lectures on ship construction and kindred subjects. In the drawing room there is made also a design of an engine for the steamship design.

The course for naval constructors differs from the regular course in that it more extensive, more advanced and in that a large amount of attention is given to warship design. The increased time assigned to this course makes it possible to give more attention to marine engines and to marine steam turbines, and also to give an extended course in electrical engineering. Graduates from Course XIII and others having equivalent preparation can take graduate work in naval architecture leading to the degree of master of science, including waship design.

The department has been fortunate in that from the liberal policy of the Corporation and by the generosity of friends of the Institute, it has been possible to provide books and instruments freely and to maintain instruction in cutting models and in mould loft work. Also lectures have ben obtained by prominent men in the profession both in this country and abroad. Last year a course of lectures were given by Mons. E. Bertin, Chief Constructor (retired) of the French Navy, the lecture being given in French, but with the advantage that a a type-written English translation was placed in the hands of the students. This year a course is announced to be given on alternate days, beginning May 10, by Mr. Sidney W. Barnaby, a well-known English naval architect, as has already been noted in a previous issue of this paper, and the author of a standard work on Marine Propellers.

SHIP CONSTRUCTION AND SHIP DESIGN

By W. S. LELAND.

The professional work of Course XIII begins with the second term of the second year with a course of lectures dealing with the processes of ship building and the lay-out and equipment of ship yards.

This course is intended to famaliarize the student with the essential elements of ship building and awaken his interest, to such an extent, that he will spend his summer months at work in some ship yard. Such summer work is of great benefit because it not only brings the student closely in touch with the practical work but aids him greatly in his professional studies of the third and fourth years.

Building slips, crane service, machine tools used in ship work, pneumatic tools, mould loft, bending frames, erecting and in fact all other fundamental processes of the actual layout of leading ship yards both here and abroad are fully discussed.

This course is followed by a trip through the more important ship yards along the Atlantic Coast if the class so desires. The importance of such a trip cannot be over-estimated, for it gives the student an opportunity to compare the dieffrent methods of our leading yards and see for himself the conditions under which they have to work.

This course is followed in the second term of the third year by a course of lectures covering the details of ship construction, the stresses existing in the hull and the best disposition of material to resist the strains.

In the fourth year this work is made to fit in with the actual drafting work of the ship design.

These lectures are illustrated frequently by lantern slides, and the department is fortunate in having several good-sized models showing various details of construction. These models are made of wood and correctly show to scale the relation of plates, angles and rivets, giving the student a far better conception of such details than could be had merely from drawings.

The actual design of a steamsip begins in the latter part of the first term of the third year and continues through the remainder of the third year and throughout the fourth year.

The preliminary dimensions of a vessel to fulfil certain requirements are determined, the general arrangement laid out to a small scale and an approximate draft of the lines made to

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THE TECH

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In this, the last of the Special Issues devoted to the courses of the Institute, The Tech wishes to express its genuine appreciation of the aid given by the contributors from the departments and from the graduates and to the advertisers, all of whom have made possible the publication of this series. It is hoped that these efforts will be a force for the betterment not only of the immediate but the future welfare of the Institute.

NAVAL ARCH. SOCIETY

By G. G. HOLBROOK.

The Naval Architectural Society was founded November 13, 1901, by the upperclassmen taking Course XIII. The object of the society was to promote the welfare of its members by bringing them in closer social contact with each other and by increasing their interest in their professional work. At first the society was composed only of members of the Junior and Senior classes but later the members of the Sophomore class were made eligible for membership.

It has been the custom in the past few years to confine the social activities to one rather formal dinner and have speeches at that time from members of the faculty and prominent members of the profession. This year it was thought that this idea did not permit a close enough acquaintance between the newly elected members and the rest of the society, so a new plan was evolved. Early in the year a very informal dinner was held at a down town cafe where only the members of the two upper calsses were present. No outside speakers were invited, the object of the dinner being merely as a sort of "get acquainted party." Later, after the Sophomores were elected to membership, a smoker was held in the Union with Professor Peabody and Dean Burton as speakers. The officers of the society have now in mind for the near future besides the formal annual dinner, other dinners and smokers at which it is hoped to have addresses of a professional nature by prominent naval architects which will doubtless be of great interest and value to all the members.

WELD MODEL

By C. H. PEABODY.

An account has already been given of an extensive course of experiments on resistance and propulsion of ships which are made possible by the generosity of Dr. Charles G. Weld. This work is to be carried on by a self-propelled model about forty feet long and eight tons displacement. In the future it is expected to build other models of various types of ships.

At the time of going to press this work is well advanced and is expected to proceed without delay as soon as the regularf work of the school will permit. The hull which was built by Stearns and McKay of Marblehead, is complete and ready to recive the machinery. When measured the model showed an exceedingly close concordance with the lines of the type ship the U. S. R. C. Manning.

A still smaller model, 23 feet long, which was built in the model shop on Garrison Street, is now undergoing tests a the Experimental Model Basin at the Washington Navy Yard. A reduced copy of the propeller of the "Manning" to the proper scale for the 40 ft. model was made and correctly machined by the Fore River Shipbuilding Company; it is also undergoing tests at the Model Basin.

The General Electric Company have nearly completed the propelling machinery for the model, consisting of a 10 K. W. gasoline electric-generating set, and a 12 horse-power motor. Both generator and motor all excited by a separate exciter which controlls the voltage on the Ward-Leonard System. This gives precise control and exact determination of power. The motor is connected by a chain gear to the propeller shaft, so that by changing sprockets, a wider variation of conditions can be given to the propeller.

The propeller thrust is to be measured by a ball-bearing thrust block that is now under construction. The thrust is to be stabilized by a relatively weak spring, the deflections of which are to be recorded on a recording device together with other data.

The recording device consists of a strip of paper six inches wide drawn over rolls by an electric motor of variable speed. There are in all nine Waterman fountain pens that can make records on this paper. All except those that have to do with recording propeller thrust are actuated by electro-magnets.

(1) The observer when the model passes the range at the beginning or end of a course presses a button, and the corresponding pen makes the record.

(2) Two pens are controlled by a chronometer marking half seconds and each fifteenth second.

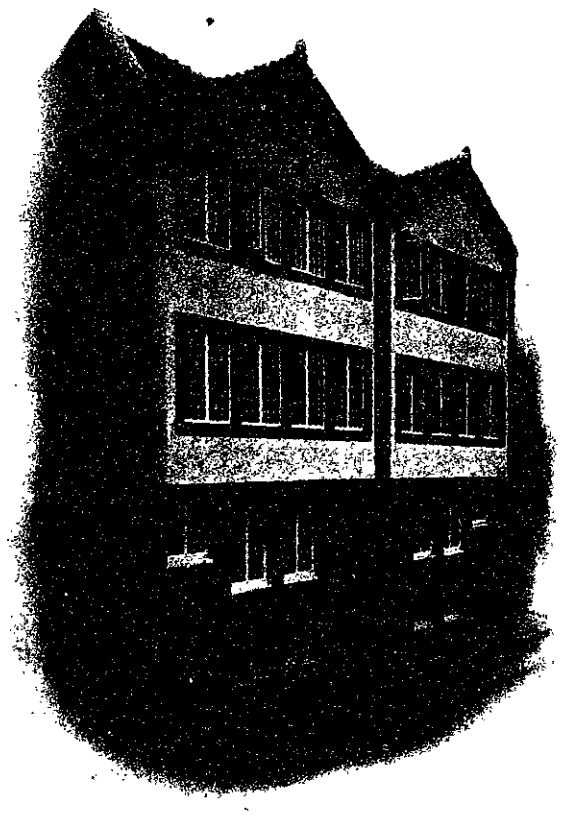
(3) A pen is controlled by the propeller shaft so that the number of revolutions can be determined directly.

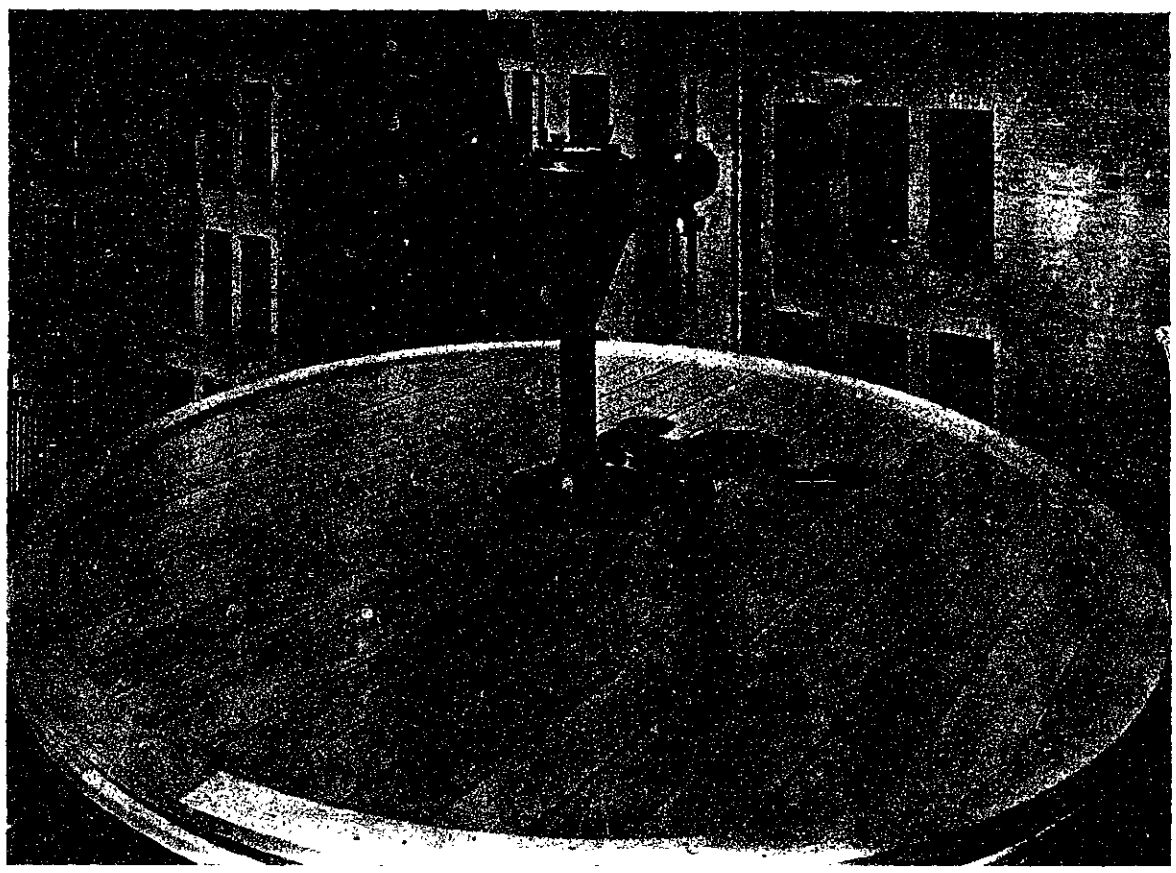
(4) Another pen is controlled by an aneemometer to record the veolcity of the wind.

(5) The deflection of the spring on the thrust device already mentioned is recorded on this same paper.

The extra pens are for use when more than one propeller is provided for the model.

One of the least satisfactory of the factors used in designing ships is the coefficient for surface friction. All determinations have hitherto been made in model baines under restricted conditions. The coefficient for models can be determined with sufficient precision, but the extension of coefficients as in tables given by Fromde and Tideman to full-sized ships is by an extrapolation that cannot carry conviction. An important feature if the investigation will be the determination of this coefficient in the open water for the conditions of the large model. For this purpose a special model is making, which is to be fifty feet long, three feet draught and one foot beam. It will in effect be a plank on edge which will make very little disturbance of the water except by friction. This model can be towed by the forty-three feet model up to eight knots an hour, and it is expected to carry the speed much higher by aid of some other craft for towing.





STANDARD NAVY COMPASS AND TURNTABLE.

COURSE XIII FROM THE UNDERGRADUATE VIEWPOINT

JUNIOR

At the beginning of the third year, when for the first time the bulk of the work lies in the Department of Naval Architecture, the characteristic which immediately makes itself felt is a sense of comparative freedom. It is impressed on your mind that the amount to be derived from the course depends on the individual student There are fewer formal recitations and the classroom exercises take on more of the character of discussions. In the drawing room the time taken for drawing depend more or less on the student since an indefinite amount of time can be spent while a result can be obtained in a comparatively short while.

A course such as Ship Design is valuable for many reasons beside the special problem itself. The problem of designing a ship to meet certain general conditions is given out, at once the student is thrown on his own responsibilities and interest is immediately aroused because of the possibility for originality.

It become necessary to get some idea as to the general design of vessels actually built for conditions similar to that which it is necessary to fulfil. Immediately great differences are apparent and the question comes up as to why such differences exist. To me the particular thing for which such a course is valuable is because to answer this question it is necessary to apply to a practical problem very nearly all the principles which have been learned before, and in this way to learn not only the application to the problem under consideration but also the general way in which such principles are applied. The other subjects taken become more real because it is continually necessary to apply them to the case in hand. Another advantage in having such a course is that the large amount of mechanical work which it appears necessary to go through with becomes much more interesting when applied to an original and not to a fixed problem.

The theoretical side of the work is more or less of the same nature, since it consists largely in an illustration of the way in which mathematics and physics are used when applied to the theoretical side of an engineering subject. It seems to me that the best feature of th course is the fact that it forces one to see things clearly in their relation to each other.

S. H. CORNELL, 1911.

SENIOR

Though there are many courses in the Institute that can boast larger numbers than Course XIII, it is really doubtful if there are many broader in scope along general engineering and scientific lines. During the first two years the instruction given is very similar to that in Course II; and in the third year, while Naval Architecture and Ship Drawing are taught, the course again closely follows Mechanical Engineering. Thus during the first three years the men receive much the same instruction as the Mechanical Engineers while they have the advantage of working in somewhat smaller classes. True, in many cases, their work deviates slightly from that in the larger course; but at the same time the work is along the same general lines, and it may well be said that a graduate in Naval Architecture and Marine Engineering carries with him the essentials of Mechanical Engineering. At the same time the student has taken the customary amount of general studies besides enough Electrical Engineering and Laboratory work to serve as a foundation for any electrical jobs that an engineer, not professing more than a general knowledge of such work might be called upon to perform. Other work in the Senior year embodies, among other things, Engineering Laboratory, Applied Chemistry, Machine Tool Work, Applied Mechanics (fourth term), and Foundry Work. While these subjects all serve for his profession they at the same time broaden his general knowledge to a great extent, which can not but be helpful to him in any work that he may undertake.

Ship design is of such a nature that it will help a man in any engineering work. A ship is one of the most complicated of structures, and is acted upon by the most varying of stresses. It is extremely difficult to ventilate, very hard to heat properly, its machinery may be of many types, and to cap the climax these things must comply with the strictest of rules to enable the owners to obtain suitable insurance rates. Thus it will be seen that the training in dealing with all of these problems at once is most complicated, and at the same time most instructive.

Marine Engines represent a class of machines that have been built for so many years in so much the same way that the fine points of design have been reached. Thus a man who can design a marine engine can well undertake the design of any ordinary steam engine Besides this course in reciprocating engines and engine room design, a course in turbine design is given in which calculations and drawings are made for "Parsons," "Curtis" and "De Laval" turbines. While these machines are also of the marine type the principals are such that they can be applied to the design of any turbine no matter what its particular use may be.

The subject "Naval Architecture," while of a very professional nature, is at the same time mathematical enough to offer the best of chances for a man to keep in constant touch with his mathematics; a thing which many graduates of the Institute complain they lost sight of before they graduated.

The openings for young men in this particular branch of engineering do not appear to be the best in Eastern United States at present, and consequently many men who have a love for ships and the sea do not take the course. In many cases this action is no doubt justifiable, but if a fellow turns to something else with no particular aim in view for the future it looks as though he were making a mistake.

It is said that this is an age of specialization, but at the same time it cannot pay to specialize too much; and for the man in doubt the broadest course can not but be the best. As shown above "Naval Architecture and Marine Engineering" is surely one of our broadest courses, because of the small sections the instruction can not help but be the best the Institute has to offer, and the work is of such a nature that it must appeal to any one with a mechanical turn of mind.

For the man who has chosen Naval Architecture as his profession, it is enough to say that Technology is considered by many ship builders abroad to be the best American school of Naval Architecture, that the United States Naval Constructors are given considerable of the same work, and that Institute men are prominent among naval architects and ship builders throughout the country.

M. P. ANDERSON.

SHIP CONSTRUCTION

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the same scale. When the lines are of approximately the right shape and as fair as can be, considering the small scale, the body plan is enlarged to a scale of one-quarter inch to the foot, the displacement figured, and the lines corrected if need be before the final fairing proceeds. The determination of the stability completes the work of the second term of the third year.

The fourth year work is devoted entirely to detail plans, computation of weight and strength, and the preparation of specifications.

The work is so planned as to throw the student largely on his own resources, thus allowing him to develop some originality. Each man works on the plans of his own ship independently of every other, and thus cannot be hampered by slow work and mistakes of fellow classmen as would happen if several worked on one set of plans. Of course each student cannot work out all details and weights in the time allowed, but he can do enough of this so that the remainder can be determined by comparison with the plans and computations already made by the Department and kept on file for this purpose.

Yacht Design.

A brief course is given in yacht design at the beginning of the first term of the third year, and serves the dual purpose of teaching the elements of fairing and of yacht design.

The student has some latitude in selecting the type of boat he prefers, but in general his choice is necessarily limited to a sloop of not over 35 ft. length over all. The boat must be disigned to the restrictions of the class chosen and the rating length as determined from the finished plans must fall within the limits imposed by the rules of the various yacht clubs. Lines, sail plan and the usual computations for displacement, centre of buoyancy, centre of lateral resistance, stability, etc., are completed, but time seldom permits of work on details of construction.

Model Making.

The department is fortunate in having a well-equipped model room where any sort of model work can be done.

The student has the privilege of making a model of the yacht he designs and is required to make one of the steamship he designs. The object of this is two-fold: first it gives him a clear conception of the form of boat which he would not be able to see from the lines alone without considerable experience, and secondly provides a model on which the shell plating can be laid off.

The process of model making is somewhat different from that usually adopted. The contours of the various waterlines are laid out on lifts and cut true to line. These lifts are then glued up and at frequent intervals a transverse cut is made to the exact shape of a particular cross-section. For this purpose a profiling machine has been especially designed. A template of thin oak is cut and trued to the exact shape of the transverse section and this is fastened to the frame so that it serves as a guide to a small circular saw driven by a motor. This saw cuts a path to the exact shape of the template and thus the glued up block is left with two sets of lines from which the student must fair away the surplus material. The accuracy with which these two sets of lines register is a gauge of the ac-

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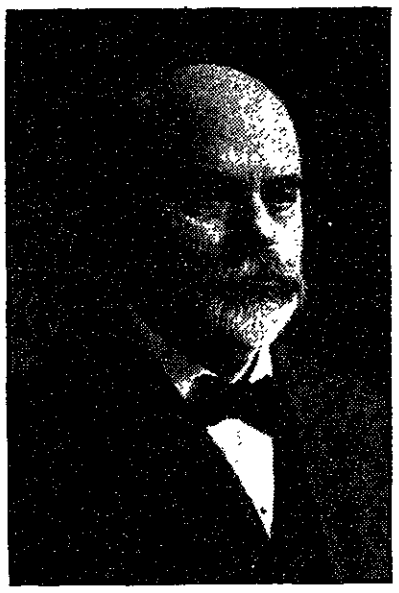
HISTORY OF THE DEPARTMENT OF NAVAL ARCHITECTURE AND MARINE ENGINEERING

By C. H. PEABODY.

A course in Naval Architecture leading to the degree of bachelor of science was offered at the Masachusetts Institute of Technology in 1893, and the first class were graduated in 1895, special arangements being made for transfer of students desiring to take that course. This was the first class graduated from such a course in America. Preliminary work had been in progress several years and instruction in naval architecture had been offered as an option in Course II. The work of the department has therefore been pioneer work as was the case of courses earlier established. The advanced condition at the Institute of methods and means of instruction in mathematics, general science, applied mechanism and steam engineering greatly facilitate the development of



PROF. CECIL H. PEABODY.

this new course; and in particular it was advantageous that the co-ordinate branch of marine engineering was established as an option in Course II as early as 1885. From the beginning Course XIII has been a course in naval architecture and marine engineering and the development of the art and science of modern shipbuilding emphasizes this industry, which is now recognized in the title of the Department.

In 1899 the Department was assigned what appeared to be commodious quarters in Engineering Building B, but immediately outgrew them and in 1904 it was transferred to the present location in Engineering Building C.

In 1901 at the request of the Navy Department the Institute established a graduate course in Naval Architecture, elading to the degree of Master of Science for officers designated for the corps of Naval Constructors and the first class was graduated in 1904. At the establishment of the course Commander Wm. Hovgaard, Royal Danish Navy was apponted profesisor of naval design.

Mr. Walter S. Leland, XIII '96, was appointed assistant professor of naval architecture in 1905. In addition to the members of the teaching staff who are on the faculty, there are now two instructors and two assistants.

MARINE ENGINEERING

By H. A. EVERETT.

All that pertains to the propulsion of vesels through the water has been commonly accepted as the sphere of Marine Engineering, so called, and while this broad expanse is the field of the course the ground actually covered in the routine work is limited, by the shortness of the time available, to the most prominent features of ship resistance, propulsion, and propelling machinery.

Ship resistance, the elements composing it, present methods of- estimating these, and the early experiments of the Froudes which form the foundation for the theory, are taken up in detail. The various methods of propulsion as by paddle wheels, propellers, sails, and hydraulic propulsion are treated and the determination of power for given speeds by the Admiralty Coefficient, Law of Comparison, and Independent Estimate methods. A problem is assigned to be figured in these three ways and this forms the basis for all later work, as the same problem is carried to completion in all of its principal branches such as the design of a suitable propeller, engine, condenser, and auxiliary machinery, and a progressive speed trial for the finished ship.

After the work on power and propeller design, the design of a marine engine, in consonance with the students' problem, is undertaken and, as but the boiler pressure, R. P. M. and power are the fixed quantities (though the type and general proportions are indicated), the work closely approaches the design of an engine "from whole cloth." It carries through to completion a preliminary determination of the various parts of the engine, basing the calculations upon the strength, or practical considerations, such as allowable bearing pressure, according to which has the predominating influence. The theoretical pressure equations, for giving the probable indicator diagrams, are solved, and from these the forces probably existing in the engine are computed and are corrected for the effect of reciprocating parts. The resultant forces are then used to determine the final dimensions of the engine.

Simultaneously with the determination of the principal dimensions and sizes of parts of the engine the work in the drawing room covers the drawing of the parts and the determination of the weights and stresses. The principal dimensions for a condenser to accompany the engine and the proper auxiliary machinery are next determined and the general arrangement of the main engine, with its condenser, and auxiliary machinery is laid out. Visits to ships and ship yards are undertaken as frequently as possible, and in the future it is proposed to have some laboratory work upon the 40 foot launch belonging to the department.

Steam turbines as applied to ship propulsion are also taken up, and designs and drawings are worked out for the De Laval, Curtis and Parsons types.

SUMMER WORK

By H. S. WONSON.

The situation of the Institute gives, to the second and third year students in Course XIII, an opportunity to engage, during the summer months, in the practical work of their profession. The Fore River Ship Yard is close at hand, and the Bath Iron Works, New York Ship, Maryland Steel and Cramp's Yards are within a reasonable distance for summer work. At almost any one of these yards temporary employment as a ship fitter's helper can be readily obtained, and the benefits to be derived from such use of the vacation period are great.

From a purely professional point of view the work is of great value. Not only does the worker acquire an intimate knowledge of the actual processes of ship construction, a knowledge which can be obtained in no other way, but he is serving an apprenticeship that will be a material aid to him in obtaining a better situation after his graduation from the Institute.

His subsequent professional work at the Institute will be greatly aided by such summer work. When the studei has actually worked on the construction of something assigned in the text book, or in the drawing room, the problem is much more interesting, more readily dealt with, and productive of greater results than if he meets it wi no previous knowledge of the methods of solution.

Aside from these points, the meeting and working with an entirely different type and class of men, getting an understanding their ways of living and working, gives one a very valuable asset, available for use in whatever line of work may be later taken up, and an asset absolutely essential to one employing or dealing with labor.

And, last but not least, a summer of hard manual labor in the open air cannot help but benefit a man physically. To one contemplating work of this sort it would be well to say that he must not expect a summer of unmitigated pleasure. Nine or ten hours a day, rain or shine, cold or hot, in a steel ship yard, bear little resemblance to picnicing, and there will be many days when one wishes ships had never been invented. If you live on your pay, which will be about eight dollars a week, you will not have much left, after paying your expenses, to spend on good times in the evenings, but you can console yourself with the fact that you won't care much whether you have or not, for the first few weeks at any rate. But after all, the game is worth the price, and, while you may not think much of the life at the time, you will never regret having had the experience, and when your summer is over, you will come back to the Institute with a clearer brain, a stronger body, and a keen appreciation of the advantages of student life over the life of a worker in a ship yard.

SHIP CONSTRUCTION

(Continued from page 75.)

curacy of the student's work in fairing and laying out the lifts.

Mould Loft.

An optional course in mould loft is offered to students at the end of the third year, covering the first ten days of the summer vacation. For this purpose the drawing room is cleaned of desks and a large floor space is available.

Before the frames of a ship can be bent it is necessary to have a drawing of the complete body plan to full size, which, of course, has to be made directly on the floor of the mould loft. To get this body plan the lines have to be carefully faired to full size on the floor or to a scale of say one inch to the foot on a glass or marble top table. Paper is not good for this purpose as the shrinkage of it may cause serious errors. It formerly was the custom in all ship yards to fair the lines full size on the mould loft floor, but now many of them both here and abroad prefer the glass-topped table, and that is the method used at the Institute. After the fairing is thus done the full-sized body plan can readily be constructed. Plating edges, stringers, floors, double bottoms, ribbands, etc., are all laid off as would be done in the ship yard enough templates are laid out to show the methods usually employed.

This work is strictly of a practical nature and gives the student an exceptional opportunity to acquaint himself with one of the vital processes in shipbuilding. It would take a man several months in a yard to pick up the points that he can here gain in ten days.

INSTRUMENTS.

DEPARTMENT LIBRARY

By HAROLD A. EVERETT.

The department library located as it is directly off from the professional drawing room, offers exceptional opportunities for study and reference. It contains some over 1,750 volumes devoted exclusively to Naval Architecture and Marine Engineering, including such allied subjects as Naval History, Steam Turbines, Docks, Cranes, Navigation, Ordnance, etc. It is, I believe, the most complete library for this branch of engineering in this country, and the attempt is made to keep the number of books down to a minimum by discarding editions superseded by later purchases and at the same time to acquire and retain all of the new publications of value. The proceedings of the world's important professional societies are taken, and also the leading professional magazines, and it is here that the great value of the accessibility of the library shows most, for in the intervals between recitation as well as when working in the drawing room, the time necessary to obtain books or periodicals for consultation is reduced to the minimum.

Several years ago the library received from the estate of Henry Bryant his collection of books on Naval Architecture and Marine Engineering, which contained many extremely old and rare volumes, several dating back as far as the 16th century, and these are segregated into a special case in one corner of the library.

Owing to the prevailing interest in air ships and aeronautics in general, the department has for the past few years been purchasing the works of the principal authorities along this line, and now has a considerable number of volumes and also subscribes to an American and a German periodical devoted to the interests of Aeronautics.

The following list of periodicals subscribed for may be of interest:

The Rudder; Yachting; Motor Boating; The Marine Review; Interantional Marine Engineering; The American Marine Engineer; The Marine Engineer; Journal of the American Society of Naval Engineers; United States Naval Institute Proceedings; The American Aeronaut; The Navy; The Shipbuilder; London Engineering; Power; Engineering Magazine; Schiffbau; Marine-Rundschau; Mitteilungen aus d. Gebiete des Seewesens; Zeitschrift des Vereins Deutscher Ingenieure; Zeitschrift fur Flugtechnik und Motorluftschiffahrt.

By HAROLD A. EVERETT.

The Department of Naval Architecture and Marine Engineering has an exceptional equipment of professional apparatus consisting, in part, of seventeen Amsler Integrators, three Fuller and two 20-inch Keuffel and Esser slide rules, two Coradi integraphs, a Denny and Johnson torsion meter, (for determining the power of ship's turbines) and has recently had built a device on the principal of the Chronograph for obtaining records of time, rev. per min., speed, etc., on a band of paper, for use on speed trials of ships. The Department also has a model-cutting machine and a frame marking machine for ship's models, two calculating machines, which will give from eight to ten significant figures, chronometers, steam engine indicators, sextant, planimeters, standary navy compass, etc.

Complete sets of drawings of ships and their machinery systematically arranged and catalogued are on file in the drawing room for reference and make it possible to illustrate current practice in the best manner in connection with the drawing room work.

GRADUATE LETTERS

The value of the training given any student during his college career will be appreciated by him to the extent that his market value has been enhanced over that of his fellows, who have not had the advantage of a college education. This may seem to be too strictly a utilitarian point of view, but for the young man thrown on his own resources, it is the only true one.

Until comparatively recent years the majority of ship yards in this country did not seem to be alive to the advantage of employing men with an education superior to that of the average schoolboy, but recently there has been a growing demand for highly trained men with a technical knowledge of their profession, such as any reputable college should give, and it is natural that there should have sprung up institutions to train men to fill the deman. Until 1883 the only school of Naval Architecture in this country was the Royal Naval College at Greenwich excepting the night schools held in winter for the benefit of shipyard employees, which are still doing excellent work. In that year, however, a chair of Naval Architecture was founded in Glasgow, followed some years ago by Armstreng College in Newcastle, and in the past few months a new centre for naval architecture training has been established in Liverpool.

I consider that the "sandwich system" gives excellent results, that is a system whereby six winter months are spent in college, and the rest of the year either outside in the Yard or in the drawing office, and most firms now allow the time spent by their apprentices in college to be included in the period of apprenticeship. The Tech man of course, who uses part or whole of his summer vacation in working in a shipyard, may regard his year as laid out to the best possible advantage.

Having satisfied himself that there exists a demand for the trained naval architect, it only remains for a young man to choose that institution where he considers he will receive the best instruction. The Tech has an international reputation, and I feel confi that very few men succeed in graduating without having acquired the faculty of straight thinking and such habits of thoroughness in their work as will stand them in good stead in business life.

As a graduate of Course XIII. I feel a little diffident in making any comments thereon, particularly as I suppose that even in the past five years there have been many changes. Have heard that the student today takes up Applied Mechanics in his second year. This I consider a very wise step, and my own experience leads me to believe that no subject yields the student a better return for his labors than th of Applied Mechanics.

I trust that a Transatlantic letter may interest those men who contemplate adopting Naval Architecture in the United States as a profession.

Yours Sincerely,
MAURICE E. DENNY,
Leven Ship Yard, Dumbarton, Scot.

The present condition of shipbuilding in America, or the immediate prospect of its revival is such that the opportunities offered to graduates of a Naval Architectural course are generally speaking, relatively few.

The one fact however which I wish to emphasize is that the general engineering training of Course XIII is excellent, and a person taking it from choice, even if unable to follow up Naval or Marine Engineering work after graduation, will find that he will have no particular difficulty in quickly working into other special lines of engineering work.

It is the training which the Institute gives, that to my mind is its source of strength. The fact of one line of special engineering offering fewer opportunities than another need not necessarily influence a man in selecting a course. The point I wish to make clear is this, the majority of graduates do not get settled for from three to five years after graduation. By settled, I mean in a position where there is something directly ahead and in work which is more nearly to be their life work than that in which they engage during the first few years after graduation. They also find that they have an immense amount to learn and "eternal vigilance" to pursue in keeping up to the times in their engineering work.

The training at the Institute gives a solid foundation upon which to commence work, and will be found of inestimable value.

Very truly yours,
W. S. NEWELL, '99,
Asst. to Superintending Engineer,
Bath Iron Works.

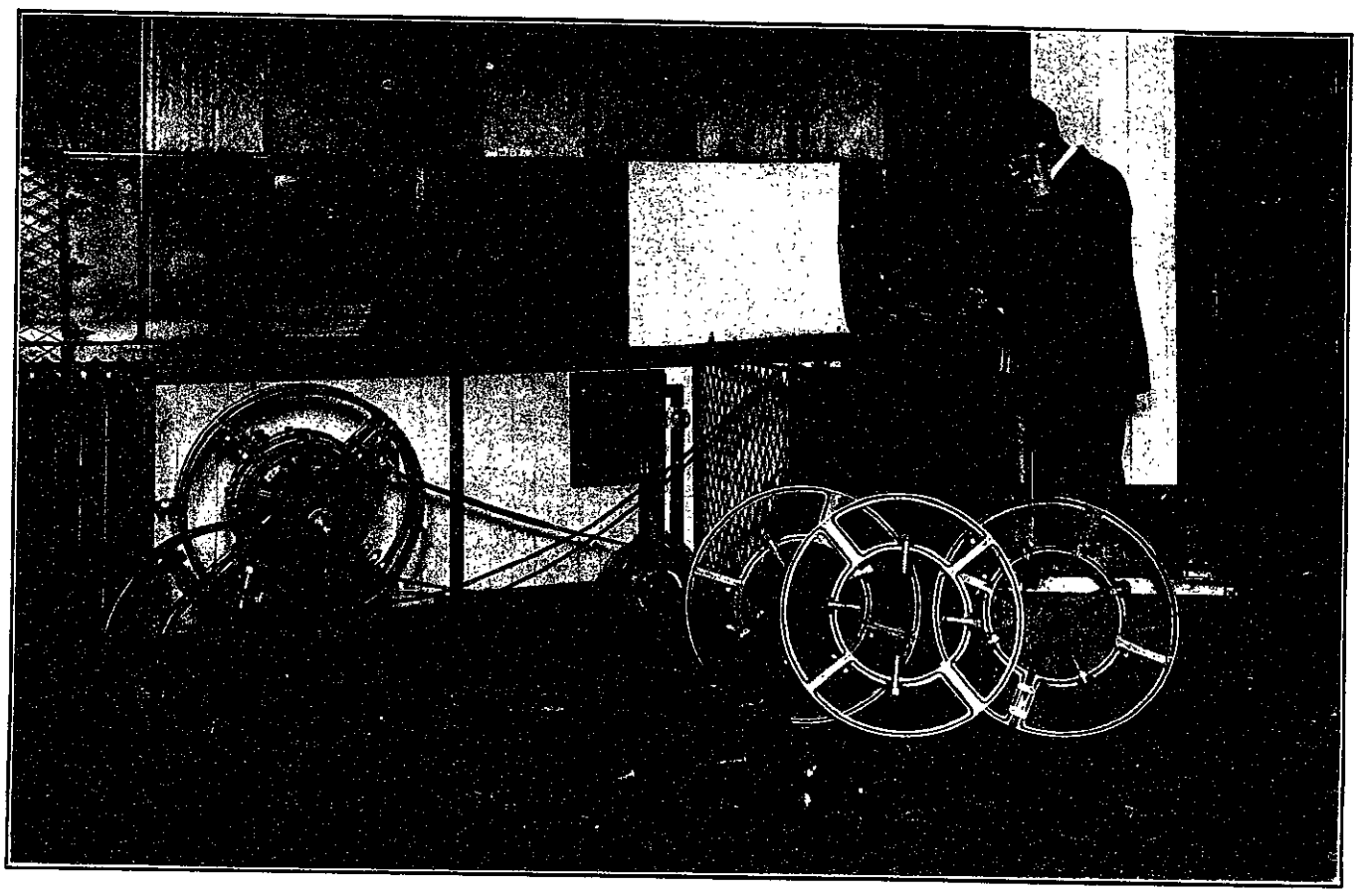
I consider the course given by the Institute in Naval Architecture to be the best course of its kind given in this country, and since graduating from the Institute I thoroughly agree with what Prof. Peabody has always said, and that is that what we want to get out of our work in college is the theory, that we can get the practice after graduation; but that theory cannot be gained after graduation.

In regard to opportunities for graduates, I wish to say that I have had several men working with me that have graduated in this course, and have found them thoroughly competent to do the work which they have undertaken. I am very glad indeed to have had this opportunity for expressing my views in regard to this.

Very truly yours,
R. B. WALLACE,
Gen. Mgr. American Ship Building Co.

There can be no question but that the training given to graduates of the M. I. T. in the course in Naval Architecture is far and away head of that given in similar courses in other technical schools. It has the great advantage of giving a much broader knowledge of the special subjects belonging to the science of Naval Architecture, and also gives a better basic and working knowledge of related engineering subjects, which is of as great value to the student as in the special training itself. Of the opportunities open to the graduates of the course, I can not say as much as I would like, but it seems almost certain that a change must soon come from the shortsightedness and disregard which has so crippled the ship building and ship owning interests of the country. The opportunities for graduates will then become correspondingly more numerous and valuable.

Very respectfully,
A. V. CURTIS,
Experimental Model Tank,
Washington, D. C.



TORSION METER AND CALIBRATION APPARATUS.

WARSHIP DESIGN

(Continued from page 73.)

dering number of solutions, fluctuating and progressing along with the technical development. Also probably unequalled are the magnitude and cost of experiments which have been carried on in time of peace to settle questions that otherwise could only have been solved through war experience.

Therefore, in order that the students should be able to benefit by previous experience, a course in warship design must begin with a historical review, explaining the causes, technical and military, which have led to the various steps in the development of warships. Such a course broadens the view of the students, affords a basis for the full understanding of the later lectures on design, and helps him to avoid the repetition of the errors of previous designers.

Accordingly, a course of the History of Development of Warship Design, going back to the middle of the last century, when steam power and armor were introduced into the navies, forms the introduction to the theoretical part of the course.

The entire course falls into two parts, a theoretical and a practical; the former consisting of lectures, and the latter of design work. It is the aim of the lectures to supplement the standard course of naval architecture with the information necessary for carrying out the design and construction of warships. The course comprises the following main subjects: Principles and Methods used in Warship Design, Structural Arrangements and Details, Preliminary Design of Machinery and Propellers and their installation in Warships, Anchor and Steering Gear, Drainage, Ventilation, and Heating, Installation of Artillery and Ammunition, and Armor Protection. These lectures are not only made descriptive, but also critical and comparative, giving not only the "How" but also the "Why" of each feature. Thus the attention of the student is drawn to the reasons why the various arrangements and constructions are used, and critical comparisons between the practice of different navies are made throughout the lectures.

The design work proper consists of the preparation of a preliminary design carried to about the same degree of completion as is the case with the designs worked out by the navy department, for the purpose of enabling contractors to make their estimates. This work embodies the preparation of lines, distribution of weights, powering of the ship, disposition of artillery and armor, storage of ammunition, arrangement of machinery and living quarters, anchor-gear, boats, steering gear, etc. Complete calculation of weight, stability, and strength are carried out in accordance with the methods used by the Bureau of Construction and Repair of the United States Navy. Detail drawings of various structural elements are also worked out. Each student prepares a half block model so as to obtain a clear idea of the form of the ship which he has designed, and on this model he lays off the outside plating, etc., as done in ship yards for determining the general arrangement of the plating and framing and the length of individual plates.

The instruction in design work is carried out in general on the following principles. First, the student studies the problem before him, guided by the explanations given in the lectures and by plans of ships of similar type and size, and selects that arrangement or construction which best conforms to the special requirements of his design. He then independently sketches out how he would solve the problem or construct the part in question, and lays it before the teacher. After being criticized by the teacher, and eventually modified, the student proceeds to prepare the final design. In this way the student is forced to make a study of the working drawings of actually built ships, and learns to exercise his judgment and to think for himself.

It is necessary in such work to have for the use of the students a great number of plans of actual ships, together with working drawings and details. This want the Institute is enabled to meet by means of a great number of plans of United States warships, about two thousand in number, which the Navy Department has loaned to the Institute for this particular purpose. Moreover, a large private collection of plans, working-drawings and compilations are at the disposal of the students.

MODEL-CUTTING MACHINE.

WIRLESS CLUB

Plans For New Station Favored By Navy Yard

Yesterday afternoon the Tech Wireless Society held its final meeting of the year and election of officers in Room 11 B.

The following men were elected for the ensuing year, President, E. H. Guilford 1912; Vice-President, J. H. Ellis 1912; Secretary, H. L. Woehling 1912; Treasurer, H. W. Hall 1912; Executive Committee, E. M. Mason 1912, E. M. Symmes 1911, J. W. Lovell 1912, and L. W. Cooper 1912.

Following this election, Mr. Ellis was called upon to make a report upon the proposed Intercollegiate Association of wireless societies. Mr. Ellis has recently been to the University of Pennsylvania, where a wireless society was established last fall, and is now in flourishing condition. This club has recently sent out a number of letters to other colleges for the purpose of forming a national association, but a yet has received reply from the Tech Society only. Accordingly the association was formed with the University of Pennsylvania and Tech as the two charter members. It is practically certain, however, that Cornell, Pinceton, and seven other colleges will join shortly. The name is to be the Intercollegiate Wireless Association; the president to be from Penn., vice-president from Tech, and the other officers from other colleges.

E. M. Symmes 1911 was then asked to give a report of the committee which interviewed the officers at the wireless station in the Brooklyn Navy Yard with regard to the society's station. Mr. W. W. Alvers, Chief Electrician of the station, expressed himself as entirely agreeable to such a proposition, and had made out suggestions for an agreement "whereby interference in the transmittal and receipt of wireless messages may be minimized." It was suggested that the Tech station should not use a wave length of less than 1,200 meters, and shall tune their wave sharp.

"Also that in case of a message being transmitted from the proposed station, should the Navy Yard station, or any naval vessel or naval wireless station signal its respective call letter and "B. K." the proposed station should cease transmitting until the messages between the naval stations or ships are completed." No limitation whatever as to hours was suggested. It is probable that an agreement containing these clauses will soon be ratified by the Government at Washington.

TECH GRAD MARRIES

Word has been received of the wedding of Miss Jessie Alice Morrison of Brockton to Calvin N. Harrub 1909. The couple will be at home after September 1 in Mundale, Mass. Mr. Harrub is connected with the filter plant at Mundale.

TECH SHOW DINNER

Entertainment and Business Reports to Close Season

The Union is the place—to-night at six forty-five is the time—and the "Queen of the Cannibal Isles" is the girl. Led by General Manager Dudley Clapp 1910, Tech Show 1910 will give its final informal performance before an exclusive audience of Show men and faculty this evening, thus winding up the year in an appropriate manner. The speeches of the evening will be very informal, and will be by the management and some of the members of the cast. At this time Business Manager Wilson will make a financial report of the Show. As this is the final criterion as to the success of the Show, this report will be awaited with great interest.

Mr. Francis will be back from Middletown for the dinner, and everything is looking very bright for a grand finale and curtain call for Tech Show 1910.

"PIPERS" VS. "PLUMBERS"

Talk about "pipers" and "plumbers"! It's a dead cinch that the "plumbers" showed their superiority over the "pipers" and after the 'pipers" issued such a unique challenge to the Course XI Sophs.

Course XI Sophs trimmed the Course X "pipers" at the Field yesterday by the score of 13 to 2 in a game of baseball that was featureless except for the wonderful display of brilliant errors.

FOOTBALL RULES

Today at noon the football rules committee, through its secretary, E. K. Hall of Dartmouth, has promised to give out its final decision on what shall be the rules of football for the season of 1910.

The committee was in session yesterday from 10 in the morning until nearly midnight and had progressed so far that by today all that will be necessary will be for the new rules to be worded properly.

More than a month ago half a dozen new rules were adopted, and so far these have been unchanged. Therefore, today, there remained for the committee to discuss only such points as affected the style of football that shall be played—that is, whether the forward pass shall be retained to make the play more open, or whether steps shall be taken so to distribute the players about the field as to make end running a more practical method of attack.

Two new plays will be presented in this city next week, for Mrs. Fiske will present during the last three days of her engagement at the Hollis Street Theatre "Hannele" and "The Green Cockatoo."

On the first three days of next week "TThe Pillars of Society" will be repeated.